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ABSTRACT

The purpose of this study was to investigate the effects of cooperative learning strategies on: (1) performance, (2) attitude toward working in teams, and (3) group behaviors in a technical training context. Subjects were 274 engineering employees enrolled in a required training class that focused on the importance of communicating technical procedures in plant operations. Subjects were divided into small groups and cooperative teams. Instruction was the same for all subjects. Only the practice portion of the lesson reflected cooperative strategies versus no process direction. Results indicated that the practice conducted in a cooperative manner had a significant effect on performance and group behaviors. Subjects in the cooperative teams performed better on the posttest, enjoyed working in teams, perceived more accomplishment, and displayed higher levels of social and cognitive interaction than subjects who worked in unstructured small groups. Implications for integrating cooperative strategies into technical team training are provided. Three tables and one figure are presented. (Contains 35 references.) (Author)

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Effects of Cooperative Learning Strategies on Performance, Attitude, and Group Behaviors in a Technical Team Environment

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Abstract

The purpose of this study was to investigate the effects of cooperative learning strategies on performance, attitude toward working in teams, and group behaviors in a technical training context. Subjects were 274 engineering employees enrolled in a required training class that focused on the importance of communicating technical procedures in plant operations. Subjects were divided into small groups and cooperative teams. Instruction was the same for all subjects. Only the practice portion of the lesson reflected cooperative strategies versus no process direction. Results indicated that the practice conducted in a cooperative manner had a significant effect on performance and group behaviors. Subjects in the cooperative teams performed better on the posttest, enjoyed working in teams, perceived more accomplishment, and displayed higher levels of social and cognitive interaction than subjects who worked in unstructured small groups. Implications for integrating cooperative strategies into technical team training are provided.

Effects of Cooperative Learning Strategies on Performance, Attitude, and Group Behaviors in a Technical Team Environment

Since the early 1980's, much emphasis has been placed on the value of forming teams in the workplace and the role they play in increasing profits and competitiveness. Total Quality Management and other similar management philosophies in business, industry, and education, point to team-based work environments as the success formula of the future (Lawler, Mohrman, & Ledford, 1992; Dobyns & Crawford-Mason, 1991). Organizations are investigating ways to motivate employees while having to trim workforce personnel to essential numbers to serve an ever-demanding customer base (Lawrence & Wiswell, 1993). To meet this challenge, groups of employees who are content experts, are being assigned to work in project teams with often little training in team building or process skills (Decker, 1993).

In the rush of American business to move from environments where individuals work in isolation to groupings of employees, the terms "teams" and "small groups" are often used interchangeably. Salas, Dickinson, Converse, and Tannenbaum (1992) suggest that a "group" continuum exists. At one extreme, highly structured, interdependent groups are placed. At the other extreme, loosely cohesive groups are found where members perform individual tasks and functions, coordinating only somewhat with the group. In many workplace situations, such as highly technical and results-oriented environments, the lack of distinctions in the definition of "group" may have extensive impact. Salas et al further suggest that those groups in place at the highly structured, interdependent end of the continuum also

perform at high achievement levels and exhibit the following behaviors: (1) a dynamic exchange of information and resources among members, (2) coordination of tasks e.g. active communication, supportive behavior, (3) constant adjustments to task demands, (4) some organizational structuring of members, and (5) interdependency among members. These group behaviors have been identified as well by other researchers (Larson & LaFasto, 1989; Dyer, 1984; Morgan, Glickman, Woodard, Blaiwes, & Salas, 1986; Foushee & Leister, 1977) and can be used to describe and define "teams." A question often raised then, is how to transform groups into teams. Surprisingly, there has been little research conducted on learning strategies to improve team dynamics and thus develop a group of independent workers into a team that exhibits characteristics such as those described.

While American business and industry struggled with this issue, educational researchers David and Roger Johnson began their work in the early 1980s with cooperative learning groups in the classroom. The Johnsons identified five elements inherent in cooperative learning groups. The elements or characteristics are (1) positive interdependence to achieve a common goal; (2) face-to-face promotive interaction; (3) individual accountability; (4) social skills; and (5) group self-assessment. These characteristics are supported by an instructor/coach who acknowledges team and individual efforts and facilitates group interaction (Johnson, Johnson, & Smith, 1991).

Since Johnson and Johnson began reporting their work in cooperative learning in 1981, many research studies have been conducted in a variety of content settings, employing many different age groups, and instructional delivery modes investigating the impact that cooperative strategies may have on performance. For example,

cooperative learning has been applied to college freshmen English composition classes (Flower & Higgins, 1991), college introductory drawing classes in Art (Murdock & Grinstead, 1989), and fifth-grade Mathematics self-contained classrooms (Mevarech, 1985). Computer-based instruction and instructional television, originally designed to be best suited for individual work, have also been fertile ground for cooperative learning studies albeit with mixed results as to performance (Hooper & Hannafin, 1991, 1988; Vereen, 1983; Carrier and Sales, 1987; and Klein, Erchul, and Pridemore, 1994). However these studies and others suggest that cooperative learning may have positive impact in other areas regardless of the effect on performance. Alleviation of math anxiety (Mavarech, Silber, & Fine, 1991), socialization and interaction (Hooper & Hannafin, 1988), positive attitudes (Doran, Sullivan, & Klein, 1993), attitudes and satisfaction (Mevarech, Stern, & Levita, 1987; Slavin & Karweit, 1981; Johnson, Johnson, & Stanne, 1986; Klein & Pridemore, 1993) suggest that members of cooperative learning groups enjoy and are positive about working in a cooperative environment.

To create positive cooperative learning environments Aronsen et al (1978) found success in structuring the process of the cooperative group. Six-member teams were assigned to learn academic material and were successful by dividing the content into sections and assigning each member a portion. Next, members of different cooperative groups, assigned the same section, met to discuss the content. Upon returning to their original groups, members would teach the entire group their specific portion. Aronsen named this method "Jigsaw" given the partitioning of the content.

For members to successfully "teach" other group members, communication and coordination was needed (Steiner, 1992; McRae, 1966; Parsons, 1981). Ross

and Raphael (1990) found that there are significant relationships between communication and achievement in cooperative learning groups where the communication involved cognitive behaviors such as contributing facts, discussion of concepts, and relevant process comments. In 1984, Smith, Johnson, and Johnson conducted a study with a group of engineering students in regard to controversy and concurrence-seeking in group discussion. Again, communication was taught as a social skill. A study by Smith (1987) supports these findings when he applied metacognitive strategies to engineering education. His work suggests that the concept of learning was enhanced by active communication as does Johnson, Johnson, and Smith (1986) when they found that group members can better engage in rational argument using active listening skills. Thus, research suggests that simply forming small groups of individuals and assigning them a task does not necessarily result in highly effective, performing units. Structuring the small group environment using cooperative learning strategies as described by these researchers point to effective task completion by the group.

These outcomes found in the educational setting are similar to those desired in the workplace of corporate America. Although cooperative strategies appear to be successful in the academic arena, there has been little application of these strategies to workplace teams. It would seem to follow that teams working within a process framework such as those described as cooperative learning strategies would accomplish more than groups that have no structure. In a highly technical environment, such as engineering, this could be especially applicable. Engineering workplace tasks are often performed in teams; however, training to perform in teams is often conducted using small groups with no group process instruction.

Thus, the purpose of this study was to examine the effect of learning strategies of participants in group contexts of either cooperative or small group structure on posttest performance, attitudes toward group structure and interaction, and group behaviors in an engineering environment. It was predicted that the small groups that applied cooperative learning strategies would demonstrate higher achievement in a practice exercise and subsequent posttest. In addition they would exhibit more interactive social and cognitive behaviors, and have a more positive attitude of working in teams than unstructured small groups.

Method

Subjects

Subjects were 274 engineering employees of a large, utility company in the southwestern United States. All subjects were enrolled in one of ten sections of a required training course. The majority of subjects in the study were male and typical of engineering professionals in education and socioeconomic status.

Procedures

This study was implemented in ten sections of a required training course focusing on the importance of communication in technical procedures in plant operations. The ten sections were scheduled over the course of three months. Two weeks prior to the study, subjects were assigned to sections by their supervisors to accommodate work schedules. An introductory letter from the Supervisor of Technical Training was sent to all subjects. The letter announced that the required training session would have a different format from previous training sessions. After subjects were scheduled into the

training sections, the sections were randomly assigned to treatment and control groups.

One instructor taught all subjects in both the control and treatment groups. The instructor was asked to read three sections in the ERIC report, Cooperative Learning: Increasing College Faculty Instructional Productivity (Johnson, Johnson, and Smith, 1991) as background information. The sections of the report were those describing the basic elements of cooperative learning, review of the research, and the instructor's role in cooperative learning. The researcher discussed this information with the instructor in preparation for drafting an outline of the lesson plan for both the control and treatment groups. At the instructor's request, a lesson plan on active listening was scripted by the researcher. The instructor and researcher incorporated cooperative learning strategies with the technical content. Finally, the active listening and technical content was combined to produce a printed instructional support document. All subjects were provided with the same instructional content and practice exercises. The difference between the control and treatment groups was limited to the structure of the practice exercises.

The original classroom seating arrangement was retained for both the control and treatment groups. This consisted of six tables with six chairs per table arranged to face the front of the room. A lectern, overhead projector, and screen were located at the front of the room. There was no assigned seating in class. Upon arrival, subjects sat wherever they chose. Four workbooks were placed at each seating position.

The instructor began all classes with a brief introduction that stated that, in addition to the topic information of the class, there would be an emphasis on team work during the practice exercises. All subjects were then presented with the instructional objectives for the class covering both active listening and the technical content. Prior to introducing the technical content, 30 minutes were devoted to information and practice of active listening skills to facilitate working in teams. Working from the printed instructional support document, the instructor reviewed a communication model presenting the differences that can occur between an intended message and a received one (Stech & Ratliffe, 1985). Overheads were used to graphically display the model. A handout on active listening skills was distributed to all subjects followed by class discussion. After the instruction, 15 minutes was devoted to the practice of active listening. Each table of six was told that they would be working as a team for the remainder of the class. Subjects in the control group were given individual copies of the practice exercise and told to stay in their teams to discuss and complete the exercise. Subjects in the treatment groups also remained in their teams; however, they were asked to move their chairs in order that face-to-face interaction could occur and to share one copy of the exercise. For both control and treatment groups, the instructor followed-up with a brief feedback discussion.

After the active listening practice, the instructor began the technical-content portion of the class by reviewing the objectives and giving a brief overview of the six case studies found in a set of four workbooks. All teams were then asked to choose a case study. The teams worked through advance

organizer questions which assisted them in analyzing the case situations and identifying the problems and/or causes. Given the engineering environment, the advance organizer questions focused on mechanical, electrical, and waste water systems as they apply to equipment and processes. Subjects were asked to discuss solutions and/or problem-avoidance strategies. Answers to the organizer questions were presented to the entire class upon completion of the practice exercise time. To aid teams in presenting key concepts of their selected case study, advance organizer questions, blank overhead transparencies and pens were provided. Teams were given one hour to prepare for their presentations during which time one team from each class was selected at random to be videotaped to record team-member interactions.

The control group teams were given no instructions in regard to team member interactions nor were they asked to evaluate their team. The treatment group teams were instructed that each member would have a specific role and responsibility. The team was to select a (1) spokesperson; (2) recorder who would take notes as to how the group functioned as a team and how well they used active listening skills; (3) question presenter who would paraphrase or interpret advance organizer questions during the presentation; (4) overhead scriptor; and (5) validator(s) who would verify answers to advance organizer questions. Treatment subjects were informed that the information collected by the recorder would be used by the team after the presentations to evaluate how well their team used active listening skills and to identify one thing that would improve their teamwork in the future.

They were also reminded that active listening is one of the many social skills needed to communicate effectively.

Upon completion of the presentations, treatment teams were again asked to convene for five minutes and evaluate their team interaction. Using the notes taken by the recorder as a reference, each team was told to: (a) discuss how well its members used active listening skills; and (b) identify one thing that would improve teamwork if the team was reassembled in the future. After five minutes, the instructor asked each spokesperson to report their team evaluation to the class.

Upon completion of control team presentations and treatment group evaluations, all subjects completed a 10-item posttest over the technical content, a 10-question attitude questionnaire, and a communication style inventory if they had not previously done so. At the conclusion of class, the posttest and attitude survey were collected by the instructor and given to the researcher for scoring. The videotape of the team was also given to the researcher.

Materials

Materials used in this study included a print-based instructional lesson, print-based instructional support materials and overheads for the instructor, a posttest, a post-lesson attitude questionnaire, and an interaction criteria scoring sheet.

The print-based instructional lesson included four workbooks produced within the service organization, a listening skills practice exercise

handout, and a handout describing team member roles and responsibilities for treatment group team members.

The first workbook contained the instructional objectives, active listening skills handout adapted from Stech and Ratliffe (1985), and advance organizer questions for each case study. Workbooks two, three, and four contained two case studies each. Each case study described an event in which a technical problem coupled with a performance technology deficiency caused a potentially dangerous situation.

The listening skills handout adapted from Stech and Ratliffe (1985) contained three sections: "Asking open-ended questions," "Paraphrasing and summarizing," and "Clarifying and confirming." The practice exercise, designed and developed by the researcher and instructor, consisted of a scenario describing a work situation in which a supervisor gave work direction to his team of four employees. Four discussion questions focusing on how well the supervisor and employees used active listening techniques followed the scenario description.

The team-member roles and responsibilities handout was based on Slavin's Jigsaw II method (1991). The handout described the roles of team members as spokesperson, overhead scriptor, question presenter, recorder, and validator(s) who was responsible for verifying the accuracy of the answers to the advance organizer questions.

The print-based instructional support materials for the course instructor included a script detailing the content and sequence of the active listening portion of the lesson and a series of overhead transparencies. The

script described the responsibility of team members in sending and receiving information and more specifically, messages. There was emphasis on the interpretation of received messages and how this affects the performance of a team task and the functioning of the team as a unit. A series of overhead transparencies that presented the team interaction objectives, communication model, and team evaluation questions used with the treatment groups accompanied the script.

Criterion Measures

The three criterion measures employed in this study were a posttest, an attitude survey, and group behaviors.

The ten-item posttest was used to measure performance. Knowledge of the highly technical content was assessed using a variety of formats including true/false, multiple choice, fill-in, and short answer. Each item was worth ten points and an answer key was used to grade each test. Partial credit was given for items 3, 4, and 5 where multiple answers were required. One person scored all tests. The Kuder-Richardson-20 internal-consistency reliability estimate of the posttest was .92.

The attitude survey was a ten-item Likert-style survey. The first nine items identified to what degree each individual liked working in teams and how well his or her team functioned as a unit in regard to learning strategies and active listening skills. Specifically the nine items targeted satisfaction from working in groups, role of each member as it related to the success of the group, face-to-face interaction, contribution of each member to the presentation, enhancement of active listening as a social skill, functioning of

group as a unit, effectiveness of training format, knowledge of common team goal, and group versus individual accomplishment. The tenth item provided an opportunity for comments concerning on-the-job teams in the workplace. The Cronbach alpha internal-consistency reliability estimate of the attitude survey was .61.

Group behaviors were identified by two reviewers while observing videotapes recorded during the sessions. An interaction criteria scoring sheet based on codes developed by Trowbridge and Duran (1984) was used by the reviewers to document interactions as they were observed. The scoring sheet contained two columns; one entitled social codes and the other entitled cognitive codes (see Figure 1). The number of social and cognitive behaviors was totaled for each observer to determine the reliability of observations. The inter-rater reliability was .95 for social behaviors and .91 for cognitive behaviors. A space for recording interaction occurrences accompanied each column.

Insert Figure 1 about here

Design and Data Analysis

A posttest-only control group design was used for this study. Analysis of variance (ANOVA) was used to test for differences between the treatment and control groups on posttest performance. Multivariate analysis of variance (MANOVA) was used to test for overall differences in attitude between the treatment and control groups. This analysis was followed by a

univariate analyses on the individual items of the attitude survey. Group behaviors were separated into social and cognitive behaviors. MANOVA was then used to analyze the differences in each set of behaviors between groups. The alpha level was set for .05 for all statistical tests.

Results

Performance

Performance was measured with the 10-item, 100-point posttest. The posttest assessed technical knowledge presented in the case studies. ANOVA revealed that subjects in the cooperative learning groups ($\underline{M}$ = 85.73, $\underline{SD}$ = 12.77) performed significantly better on the posttest than those in the control groups ($\underline{M}$ = 82.33, $\underline{SD}$ = 13.82) [$F(1,274) = 4.473$, $p < .05$].

Group Behaviors

Fourteen (14) observable group behaviors were identified as either social or cognitive interactions and thus analyzed separately. Mean scores and standard deviations for social and cognitive behaviors are given in Tables 1 and 2.

Insert Table 1 about here

Insert Table 2 about here

MANOVA revealed a significant effect for overall social behaviors [$F(7,69)=78.26$ $p < .05$]. Treatment group subjects interacted more than

control group subjections for five of the seven social behaviors. The first behavior identified individuals who agreed with other group members. The treatment groups exhibited more outward show of approval or agreement than control groups, $F(1,7) = 62.06$, $p < .001$ (means = 6.80 and .80, respectively). The second observed behavior which indicated significant differences was encouraging others in the group. Treatment group members encouraged others more often than control group members, $F(1,7) = 48.05$, $p < .001$ (means = 6.20 and .80, respectively). Next, group members were observed giving help to one another. The treatment group members helped each other significantly more than the control group members, $F(1,7) = 6.42$, $p < .05$ (means = 4.60 and 1.20, respectively). The fourth social behavior identified group members taking turns discussing or sharing materials. Overall, the treatment groups exhibited more behavior of taking turns than the control groups, $F(1,7) = 7.64$, $p < .01$ (means = 4.00 and .80, respectively). The last social behavior that revealed significant differences identified individuals soliciting others for information and opinions. Treatment group members did more polling of others than control group members, $F(1,7) = 143.40$, $p < .001$ (means = 9.00 and .20, respectively).

MANOVA also revealed a significant effect for overall cognitive behaviors [$F(7,69)=114.64$ $p < .05$] with significant differences in six of the seven cognitive behaviors. The first cognitive behavior that tested significant was asking for suggestions. The treatment groups overall asked for suggestions more often than the control groups $F(1,7) = 32.34$, $p < .001$ with means of 7.00 and 1.20 respectively. Coupled with asking for suggestions,

the next behavior identified with significant differences, was responding to suggestions. The treatment group responded more to suggestions than the control group responded to suggestions $F(1,7) = 12.78$, $p < .01$. The differences in means were 7.20 for the treatment group and 1.80 for the control group. The third behavior observed with significant differences was explaining how to do various procedures involved with tasks. Treatment group members explained more often to others in the group than control group members $F(1,7) = 73.50$, $p < .001$ with means of 5.20 and 1.00 respectively. Asking a question was the fourth cognitive behavior that yielded significant differences. The treatment groups asked more questions of their members than control groups $F(1,7) = 33.71$, $p < .001$. The means were 7.20 and 1.80 respectively. The fifth cognitive behavior was interpretation of tasks and concepts in group members' own words. Treatment group members interpreted topics by giving their own opinions more than control group members $F(1,7) = 18.33$, $p < .001$ with means of 12.00 and .80 respectively. The last behavior that revealed significant differences was the evaluation of answers to the advance organizer questions using criteria. Treatment members referred to the case studies as resource material, matching question components with answers with other members of the group $F(1,7) = 60.16$, $p < .001$. Control group members did not exhibit this behavior in any of the control groups as evidenced by the means, 3.80 (treatment) and 0.00 (control).

Attitude

Attitudes toward working in groups were measured with a 10-item, Likert-style survey. Mean scores and standard deviations for each item are provided in Table 3.

Insert Table 3 about here

Nine items were considered for analysis. The last item asked for comments and was therefore not included. MANOVA did not reveal a significant effect for overall attitude $F(9,184) = 1.71$, $p > .05$. However, follow-up univariate analyses revealed significant differences on four of the nine items. The first two items referred to satisfaction and sense of accomplishment. The treatment group experienced more satisfaction than the control group as indicated by their response to the item, "I enjoy working in groups to accomplish a task," $F(9,184) = 7.21$, $p < .01$ (means = 2.23 and 2.00, respectively). The treatment group perceived a greater sense of accomplishment as suggested by their response to the item, "I think that we accomplished more as a group than we could have if we had worked individually on our assigned content," $F(1,184) = 4.32$, $p < .05$ (means = 2.00 and 2.05, respectively). The third item revealing significant differences concerns seating arrangement. Face-to-face seating was perceived by the treatment group to be more important in promoting interaction than it was by the control group as evidenced by the item, "The physical seating arrangements of my group contributed to the positive interaction of all members," $F(1,184)$

= 6.86, $p < .05$ (means = 2.96 and 2.89, respectively). Significant differences were also found for importance of goal recognition as seen in the treatment group members response to the item "My group knew the goal of the group and understood its importance," $F(1,184) = 3.96$, $p < .05$ (means = 2.23 and 2.5, respectively).

Discussion

The purpose of this study was to investigate the effect of learning strategies on posttest performance, attitudes toward group structure and interaction, and group behaviors in a small group context. Treatment subjects used cooperative strategies to complete assigned tasks while control subjects were left on their own to use whatever learning strategies they wished to complete the exercise. As predicted, subjects in the treatment group performed better on the posttest than control group subjects. These results are likely due to the structured nature of the cooperative strategies used by the treatment group. The treatment small groups were asked to complete their assignment while following very specific directions similar to those of Aronson et al (1978). Subjects were told to physically change their seating arrangement to accommodate face-to-face interaction. Treatment group members were each assigned a duty or role to play during the exercise and given only one copy of the exercise. Subjects were also reminded that active listening is only one of many social skills necessary to better communicate with group members (Smith, Johnson, & Johnson, 1984; Smith, 1987). They were alerted to be attentive to the interactive processes that were taking place within the group while they completed their assignment because they would be conducting group self-assessment at the end of the class.

Analysis of the videotaped interaction of the treatment groups verified that subjects did accomplish their tasks using the cooperative strategies. In all cases of the treatment groups the members attended to task almost immediately. The leader facilitated the assignment of tasks needed to complete the exercise. Two of the groups opted to work through all of the advance organizer questions together. This allowed for much discussion. The other three groups agreed to assign each team member a certain number of questions. They worked individually and then returned to share their information and validate it with case study references. There seemed to be purpose and direction to their activities as evidenced by supporting body language. Members leaned forward, nodded their heads affirmatively, and gestured to other members. These behaviors were in contrast to those strategies used by the control group. In all cases, the control small groups worked individually to answer the advance organizer questions and complete the exercise. At the beginning of the practice time, a natural leader emerged to facilitate the assignment of questions. Each individual in the group was asked to volunteer to answer one or more of the questions. If no one volunteered, the natural leader assigned the question to a group member. The overheads required for the presentation were passed from one individual to the next with no discussion as each completed their portion. The control groups, appearing to be stifled by the seating arrangement, displayed little body language that could be interpreted as contributing to supportive peer interaction. There was little planning or rehearsal for the class presentation allowing for most control subjects to leave the room for an early break. Thus, cooperative strategies appeared to affect both the quality and quantity of the interaction. An examination of the means for the social

and cognitive behaviors supports this observation as well as much of the research in cooperative learning studies.

The results of the attitude survey support the observations of the cooperative group behaviors. Cooperative subjects believed that they accomplished more working in a group than they could have working alone and indicated that they enjoyed the group experience more than did the control subjects. This could be attributed to the greater quantity of interaction among cooperative team members. The high degree of interaction by the treatment group suggests that verbal behaviors such as those observed are highly suggestive of thinking activity (Trowbridge & Duran, 1984). The added reinforcement and rehearsal of concepts taking place suggest that learning is being enhanced as Smith (1986) found. When asked if they knew the group's goal and its importance, cooperative team members had a higher level of agreement with this statement than control groups. Again, this could be the outcome of increased interaction where discussion, clarification, and reiteration of content took place.

Although results were not significant, it is interesting to note that control team members agreed with the statement "My group could have functioned better" to a greater degree than the treatment team members. A possible explanation for this perception is that control teams were given no instruction in group processing and physically were sitting on one side of a long table. Those seated near the ends of the table could not easily participate in either social or cognitive interaction making communication more difficult. Hence, future room arrangement might include group members facing each other to allow more opportunity to interact.

While viewing the videotapes of the treatment and control groups, an unexpected behavior was observed. In all of the control groups and a few of the

treatment groups, off-task conversation was noted. There appeared to be more such conversation among control group members than treatment group members. Since this behavior did not fit either original behavior scale, it was not recorded. However, in future studies the nature of such off-task conversation may give insight into the interpersonal relationships of group members and how it may contribute to or hinder performance.

This study has immediate and local implications. After reviewing the results of the current study and listening to learner comments outside of class, the instructor in this study made two modifications to future training sessions. Members of classroom teams are to have assigned duties and roles and the classroom furniture is to be rearranged to facilitate face-to-face interaction.

The current study also suggests on a broader level that the application of cooperative learning strategies to business and industry is possible and highly desirable (Russ-Elf, 1993) for teams that are quickly formed and have a relatively simple project or task to accomplish. Implications for those who design training for highly technical environments such as engineering might consider using cooperative learning strategies as a means of increasing team interaction and performance in the classroom. Thus,.the results of this study imply that using cooperative learning strategies may be one method of developing groups of independent workers into effective teams at least on the short term.

Limitations of this study and future research include the inability of the research to be conducted over time and in other training settings. It would be interesting to look at the consistent and continued use of cooperative strategies in technical training. Possible research questions might include the following. Over the

long-term would cooperative learning strategies help a group of individuals evolve into a highly effective team? Could the Jigsaw method continue to be used as team members become more and more a part of problem-solving? How would cooperative strategies contribute to teams as members take on more responsibility and empowerment? Can cooperative learning strategies be a means of building the working foundations of empowerment in the workplace? Can cooperative strategies enhance communication among individuals who do not normally interact on a peer basis? i.e., can they breakdown organizational structure barriers? Can cooperative learning strategies contribute to a lessening of cultural and workplace tensions caused by cultural diversity ? These and other questions address some of the many issues that are commonplace in business and industry. As teams become more prominent in the American work environment more reserch needs to be done to determine methods of developming teams to their greatest potential.

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Table 1

Mean scores and standard deviations for observed social behaviors.

Behaviors	Treatment Groups	Control Groups
Approval, agrees with others*	6.80	.80
	(1.32)	(.75)
Disapproval, disagrees with others	.20	.00
	(.40)	(.00)
Encourages others*	6.20	.40
	(1.60)	(.49)
Gives help*	4.60	1.20
	(2.24)	(1.47)
Takes turns*	4.00	.80
	(2.10)	(.98)
Gives or delegates task	.80	.40
	(.75)	(.49)
Polls others, solicits*	9.00	.20
	(1.41)	(.40)

* $p < .05$

Table 2

Mean scores and standard deviations for observed cognitive behaviors.

Behaviors	Cooperative Groups	Small Groups
Tells, directs	2.20	2.00
	(1.47)	(.63)
Asks for suggestions*	7.00	1.20
	(1.41)	(1.47)
Responds to suggestions*	7.20	1.80
	(4.68)	(2.22)
Explains*	5.20	1.00
	(.75)	(.630)
Asks a question*	7.20	1.00
	(4.19)	(.63)
Interprets in own words*	12.00	.80
	(5.54)	(.75)
Evaluates using criteria*	3.80	0.00
	(.98)	(0.00)

* $p < .05$

Table 3

Mean scores and standard deviations (SD) on attitude survey

Items	Treatment Groups	Control Groups
1. I enjoy working in groups to accomplish a task.*	2.23	2.00
	(.96)	(.82)
2. All members of my group were integral to the	1.98	1.89
group's success.	(.89)	(.80)
3. The physical seating arrangement of my group	2.96	2.89
contributed to the positive interaction of all members.*	(1.22)	(1.19)
4. Each member of my group contributed to the effective-	2.01	2.03
ness of our presentation and success of the group.	(.86)	(.98)
5. Using active listening skills enhanced communication	2.22	2.13
in my group.	(.91)	(.84)
6. My group could have functioned better.	2.38	2.44
	(.81)	(.96)
7. I will be better able to function as a team member in the	2.84	2.76
future after having participated in this new training format.	(1.08)	(.91)
8. My group knew the goal of the group and understood	2.23	2.05
its importance.*	(.91)	(.71)
9. I think that we accomplished more as a group than we	2.27	2.05
could have if we had worked individually.*	(1.14)	(.98)

Likert values: 5-strongly disagree, 4-disagree, 3-neither agree or disagree, 2-agree, 1-strongly agree, 0-N/A

* $p < .05$

Figure Caption

Figure 1. Interaction criteria scoring sheet used to identity social and cognitive behavior in the analysis of videotaped observations.

Social Codes:

_____ approval, agrees with others

_____ disagrees with others

_____ encourages others

_____ gives help

_____ takes turns

_____ gives or delegates task

_____ polls others, solicits

Cognitive Codes:

_____tells, directs

_____asks for suggestions

_____explains

_____asks a question

_____responds to suggestions

_____interprets in own words

_____evaluates using criteria